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BLACK GRAIN-STEM SAWFLY OF EUROPE[1] IN THE UNITED STATES.

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INTRODUCTION.

That another exotic insect with possibilities for damage to agriculture has become established in America, that it is now quite widely distributed, and that it has already begun to make itself felt was brought to light during the summer of 1918. In view of its probable future importance and the consequent desirability of learning as soon as possible the facts about its distribution, food plants, and injuriousness, it is deemed expedient to bring the matter to the notice of entomologists and others through publication at this time of such information as is at hand.[2]

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[1] *Trachelus tabidus* (Fab.).

[2] The writer is indebted to Miss Margaret Fagan, of the Bureau of Entomology, for compilation of the appended bibliography; to Messrs. W. R. McConnell, P. R. Myers, and W. J. Phillips, also of the Bureau of Entomology, for reared and collected material and notes which were invaluable in establishing the identity and distribution of the insect; to Dr. J. Chester Bradley, of Cornell University, for larval material of *Cephus pygmaeus* as well as useful suggestions regarding characters for separating the larvæ; and to Messrs. S. A. Rohwer and Wm. Middleton for numerous helpful suggestions.

HISTORY OF DISCOVERY OF THE INSECT IN AMERICA

Specimens of a sawfly were collected by C. W. Johnson at Riverton, N. J., some time prior to 1899, the exact date unknown. These were submitted to Dr. W. H. Ashmead for determination and pronounced by him a new species, to which he gave the manuscript name of *Calameuta johnsoni.* Under this name, misspelled *Calamenta johnsoni*, the record was published, without description, in the second edition of Insects of New Jersey, by John B. Smith (39).[1] A description based on these specimens was later published by Ashmead (40). Subsequently the type specimens were examined by Dr. J. Chester Bradley, who recognized in them the European species *Trachelus tabidus* Fabricius, and under this corrected name the record of the original collection was again published in the third edition of Insects of New Jersey (45). At that time, and for some time thereafter, nothing was known of the food plants of the species in this country. Such European records as existed were in the Russian literature, and because of difficulty in translation were largely overlooked. Since *Trachelus tabidus* was not known to be causing any injury, no particular attention was paid to it.

During the summer of 1918 a complaint was received by the Bureau of Entomology from a correspondent at Gaithersburg, Md., regarding the work of some insect which had caused his ripening wheat to fall badly, and the writer was detailed by Mr. W. R. Walton, in charge of Cereal and Forage Crop Insect Investigations, to investigate the outbreak.

Specimens of the injured stalks were received from the correspondent, some of which proved to contain larvæ of what was readily determined as a species of Cephidae. The insect was at first thought to be either *Cephus pygmaeus* Linnaeus or *Cephus cinctus* Norton. The former species had been known in the vicinity of Ithaca, N. Y., many years before, but so far as the records indicated, had succeeded in spreading but little from the point of original infestation and had never been recorded as seriously injurious. *Cephus cinctus* was known only from the western United States and was not believed to occur east of the Mississippi River except for a few localities in Michigan.

When the Maryland infestation was brought to the attention of Mr. S. A. Rohwer, specialist on sawflies, of the United States Department of Agriculture, Bureau of Entomology, he at once suggested the possibility that the insect might be *Trachelus tabidus* Fabricius. Several adult specimens of this species in addition to those originally taken at Riverton, N. J., were in the United States National Museum. These, as shown by the labeling, were collected at two or three different points in Maryland and Pennsylvania. The fact that *Trachelus tabidus* was thus known to occur in the region of the infestation and that it was the only species of Cephidae known to occur there which would be likely to have the habit attributed to this one, at once established a strong probability that it was the species concerned. This suspicion was confirmed when Messrs. W. R. McConnell and P. R. Myers, who had been engaged for several years in investigating the insect enemies of wheat and other cereals for the Bureau of Entomology in Maryland and Pennsylvania, turned over to the writer all of the sawfly material which they had secured from that region. This material all proved to be *Trachelus tabidus* and included several specimens which had actually been reared from wheat stubble in breeding cages, as well as numerous specimens collected by sweeping wheat. The reared material left little doubt as to the identity of the depredator in question. Reference to the European literature, especially that by a number of the more recent Russian entomologists, regarding *Trachelus tabidus*, cleared up whatever lingering doubts might still have existed.

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[1] Numbers in parenthesis refer to "Literature cited," p. 14.

The manner in which this insect became established in America is unknown and probably will remain a mystery. Any surmise as to the probable manner of introduction would be valueless and since it could have no effect upon the fact that it probably has come to remain, is omitted.

COMMON NAME OF THE SPECIES.

In Russian literature this species is referred to as the black sawyer or black sawfly because of its nearly uniform black color. The writer has ventured to modify this name to some extent by calling it the black grain-stem sawfly. This name is descriptive of the insect as well as of its habit and at the same time minimizes the possibility of confusion with other black species of sawfly.

DISTRIBUTION.

OLD-WORLD DISTRIBUTION.

André (33) records the species as occurring in England, France, Sweden, Spain, Germany, Italy, Algeria, and Syria. Cameron (35) in his "Monograph of the British Phytophagous Hymenoptera" gives practically the same distribution, omitting France. Konow (42) in Genera Insectorum cites middle and southern Europe, Algeria, and Asia Minor. Several writers, including Shtchegolev (49), Kurdjumov (48), Uvarov (50, 54), Zolotarevsky (53), and Borodin (52), have recorded it more recently from central and southern Russia, while Kulagin (47) states that *Cephus pygmaeus* and *Trachelus tabidus* have been recorded from 26 different governments of Russia.

From this it will be seen that the species occurs in all three Old World continents, being present throughout most of the middle and southern European countries, southeastern Asia, and northern Africa. It is probable that it will eventually be found to be present throughout most of the remaining regions where wheat is grown in Europe and eastern Asia, as well as northern Africa.

DISTRIBUTION IN AMERICA.

The present distribution in America, gleaned from the writer's investigations, the records of Messrs. McConnell and Myers, which were kindly placed at his disposal, specimens in the United States National Museum, and a note furnished by Dr. J. Chester Bradley, includes localities in six States, viz: New Jersey, Virginia, Delaware, Maryland, Pennsylvania, and New York.

The localities where the insect is at present known to occur, together with the date of collection and the name of collector, are as follows:

Riverton, N. J., adults collected by C. W. Johnson, May 29 (year not given but prior to 1899); East Falls Church, Va., hibernating larvæ in wheat and rye stubble, A. B. Gahan and S. A. Rohwer, collectors, August 6, 1918; Warrenton, Va., larvæ collected in August, 1918, by W. J. Phillips; Harrington, Del., larvæ collected in wheat stubble by W. R. McConnell; Wolfsville, Md., adults swept in clover field by J. A. Hyslop, June 6, 1914; Hagerstown, Md., adults swept from wheat by P. R. Myers and W. R. McConnell, May 15, May 25, June 4, 1915, and May 24 and June 8, 1916; Hagerstown, Md., adults reared from wheat stubble by P. R. Myers, May 10, 1916, and by W. R. McConnell, May 3, 1917; Taylors Island, Md., adult reared from wheat stubble by W. R. McConnell, March 21, 1917; Great Falls, Md., adult swept by Frederick Knab, May 24, 1914; Germantown, Md., larvæ injuring wheat received from a correspondent by the Maryland State College of Agriculture, and recorded under the name of *Cephus pygmaeus* in Report of Maryland State Horticultural Society, 1914; Gaithersburg and Laytonsville, Md., hibernating larvæ collected by A. B. Gahan in wheat stubble, July 22, 1918; College Park, Md., hibernating larvæ in wheat by A. B. Gahan, July 24, 1918; Berwyn, Md., hibernating larvæ in rye stubble collected by A. B. Gahan, July 30, 1918; Laurel, Md., hibernating larvæ in wheat stubble, by A. B. Gahan, July 26, 1918; Towson, Md., hibernating larvæ in wheat stubble, by A. B. Gahan, August 2, 1918; Warfordsburg, Pa., adult reared from wheat stubble by P. R. Myers, June 5, 1916; Hunters Run, Pa., adult reared from wheat stubble, W. R. McConnell, May 7, 1918; West Chester, Pa., adult collected by H. L. Parker, June, 1915; Linglestown, Pa., adults collected by H. B. Kirk and A. B. Champlain, May 26, 1908; Herndon, Pa., adults, collector unknown, June 6, 1907; State College, Pa., adult swept in clover by W. R. McConnell, May 30, 1911; Carlisle, Pa., larvæ collected July 23, 1918, by C. C. Hill, and July 31, 1918, by W. R. McConnell; Mt. Holly Springs, Pa., larvæ collected in wheat stubble, June 25, 1918, by McConnell and Myers.

In addition to these records Dr. J. C. Bradley states that he has seen one adult specimen in the collection of the Brooklyn Museum from Long Island, N. Y.

These records probably indicate only approximately the present distribution (fig. 1) of the species. A more extended investigation will be necessary to establish the exact limits. The records are sufficient to establish a probability that it already occurs over the greater part of Virginia, Maryland, Pennsylvania, New Jersey, and Delaware, and it is possible that West Virginia, eastern Ohio, southern New York, and even some of the New England States may already be included within its range.

PROBABLE FUTURE DISTRIBUTION IN AMERICA.

Judging by its wide distribution in the Old World, as well as by the character of localities already included within its range in this country, including both tidewater and mountain districts, there seems little reason to doubt that the species will eventually spread over all the wheat-growing sections of the eastern and central United States. Whether it will accommodate itself to the arid and semiarid wheat-growing districts of the West is matter for speculation. The average precipitation of this region does not differ greatly from that of southern Russia, where the species seems to be at its worst. The mean temperatures of the two regions probably are not widely different. It seems possible, therefore, that unless some other climatic or physical factor intervenes, the species may spread eventually from coast to coast. That it will spread northward into Canada may be doubted, since in Europe, although recorded from Sweden, it seems not to occur generally in the colder northern portion.

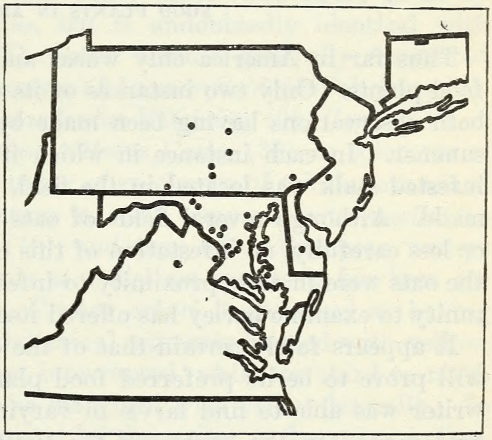


FIG. 1.—Present known distribution of *Trachelus tabidus* in America.

FOOD PLANTS.

FOOD PLANTS IN EUROPE.

In European literature, with one exception, the records of food plants of *Trachelus tabidus* are by Russian entomologists. Rudow (43), in speaking of *Cephus satyrus* Panzer, *C. nigrinus* Thomson, *C. pallipes* Klug, *C. arundinis* Giraud, and *C. tabidus* Fabricius, makes the general statement that in southern Europe these species live in

Triticum repens, Bromus, Holcus, and reeds or bulrushes, without specifying which plants serve as host plants for the different species. The record is, therefore, too general to be of much value in the present circumstances.

The Russian records are more specific and apparently all refer to infestation of small-grain crops. Shtchegolev (49) records the species as a serious pest of wheat; Borodin (52) reared it together with *Cephus pygmaeus* from barley and both spring sown and winter sown wheat; Kulagin (47) states that it infests rye and wheat in the Province of Taurida. Various other Russian writers, including Uvarov (50) (54), Zolotarevsky (53), and Kurdjumov (48), have recorded the species as attacking the grain crops, principally wheat.

FOOD PLANTS IN AMERICA.

Thus far in America only wheat and rye are known to serve as food plants. Only two instances of its occurrence in rye are known, both observations having been made by the writer during the past summer. In each instance in which it was found in rye only one infested stalk was located in the field, although careful search was made. Although several fields of oats stubble were examined more or less carefully, no infestation of this crop was observed even when the oats were in close proximity to infested wheat fields. No opportunity to examine barley has offered itself.

It appears fairly certain that of the cultivated grain crops wheat will prove to be its preferred food plant. As stated elsewhere, the writer was able to find larvæ in varying quantities in every wheat field visited in the course of the limited investigation carried on during the summer of 1918.

That the species eventually will be found to infest plants other than the small grains is possible. The related species, *Cephus cinctus*, which also infests the small-grain crops in our Western States, is known to have a long list of food plants among the coarser grasses, both wild and cultivated. *Cephus cinctus* is believed, however, to be a native species whose original food plants were wild grasses and whose habit of attacking the cultivated grains has been induced through elimination or reduction of its natural source of food supply by the development of agriculture. Present information indicates that the natural food plants of *Trachelus tabidus* are the small grains, although it may yet prove to have other hosts in Europe. It is doubtful whether the species which has been transplanted from its native habitat to America will find it possible to develop in our native grasses. Only future investigation can determine. The possibility of its being able to maintain itself upon grasses other than the small grains should be borne in mind, and such grasses as Elymus, Bromus, Agropyron, and in fact any of the cultivated or wild grasses whose seasonal development is such as to provide a succulent stem of sufficient size to accommodate the larvæ during the period of larval activity, May and June, should be viewed with suspicion.

SYNONYMY AND DESCRIPTION OF TRACHELUS TABIDUS.

Since the original description by Fabricius (1), the name has undergone a number of generic transfers, and it has been redescribed or referred to under several specific names.

It is the opinion of the writer, however, that some of the published synonymy is incorrect. *Trachelus haemorroidalis* Jurine (17) is listed as a synonym by Dalla Torre (38). The figure given by Jurine is not that of *tabidus*, but is undoubtedly identical with *Cephus analis* Klug (12). The latter name is generally recognized by European writers as a synonym of *haemorrhoidalis* Fabricius (2). Konow (41) includes *Sirex macilentus* Fabricius (9), *Cephus erberi* Damianitsch (30), and *Cephus vittatus* Costa (32) as color varieties of *tabidus*. The large number of specimens of *tabidus* examined by the writer show no variation in color comparable to *macilentus* as illustrated by Coquebert (10), and since other European writers generally have recognized this as a distinct species it has been excluded from the synonymy. *Cephus erberi* is described as having the third to seventh dorsal abdominal segments banded with yellow, the band on the third segment interrupted, while the third to ninth ventral segments are said to be margined with yellow laterally. In no specimen of *tabidus* examined by the writer is there any indication of a dorsal band of yellow on the abdomen nor are the ventral segments margined with yellow. Like *macilentus*, this species is therefore excluded from the synonymy. The description of *vittatus*, on the other hand, agrees closely with *tabidus*, and there seems to be no good reason why it should not be considered a pure synonym instead of a color variety.

Following is the complete synonymy of *Trachelus tabidus* as understood by the writer:

Trachelus tabidus (Fabricius) Jurine.

Sirex tabidus Fabricius (1), (2), (4).—Villers (5).—Linné (6).—Christ (8).—Fabricius (9).—Coquebert (10).—Walckenaer (11).—Rossi (19).—Herrich-Schäffer (26).—Duméril (29).

Tenthredo longicollis Fourcroy (3).—Villers (5).

Astatus tabidus Klug (12).—Panzer (15).

Cephus tabidus Fabricius (13).—Latreille (14).—Panzer (16).—Latreille (18).—Lepeletier (20).—Stephens (23).—Hartig (24).—Blanchard (25).—Lucas (27).—Costa (28).—Taschenberg (31).—André (33).—Cameron (34), (35).—Magretti (36).—Costa (37).—Dalla Torre (38).

Trachelus tabidus Jurine (17).—Curtis (22).—Konow (41), (42).—Rudow (43).—Kokujev (44).—MacGillivray (45).—Kholodkovsky (46).—Kulagin (47).—Kurdjumov (48).—Shtchegolev (49).—Uvarov (50).—Borodin (52).—Zolotarevsky (53).—Uvarov and Glazunov (54).—MacGillivray (55).—Howard (56).

Cephus nigritus Lepeletier (20).

Cephus vittatus Costa (32).

Calamenta johnsoni Ashmead (39).

Calameuta johnsoni Ashmead (40).

Cephus pygmaeus Cory (51), not Linnaeus.

ADULT.

Female.—Long and slender, with abdomen somewhat compressed. Antennæ longer than thorax, thickened at apex, third joint slightly shorter than fourth, third to eighth joints four to five times as long as thick, those beyond eighth gradually shortening, the ones in thickened portion of antennæ subequal and not longer than broad; clypeus truncate at apex, with sharp lateral angles; occiput concave; greatest width of posterior orbit about equal to greatest transverse diameter of eye; pronotum elongate, nearly as long as broad, broadest at posterior margin, its sides more or less concave; mesoscutum and scutellum subequal in length; middle and hind tibiæ each with two apical spurs and normally each with two (sometimes one only) superapical spurs located at about the apical one-third of tibiæ; abdomen much longer than head and thorax, subcompressed, with sheaths broad and slightly thickened at apex. Polished black; mandibles except at apex, small spot below tegulæ, apex of front femora within, inner side of front tibiæ for its whole length, spot at apex of median femora in front, a broad longitudinal stripe along lateral margins of dorsal segments, a lateral spot on seventh ventral segment, and a narrow marginal stripe on basal part of sheaths yellow; wings subhyaline, nervures and stigma black. (See Pl. II, A.)

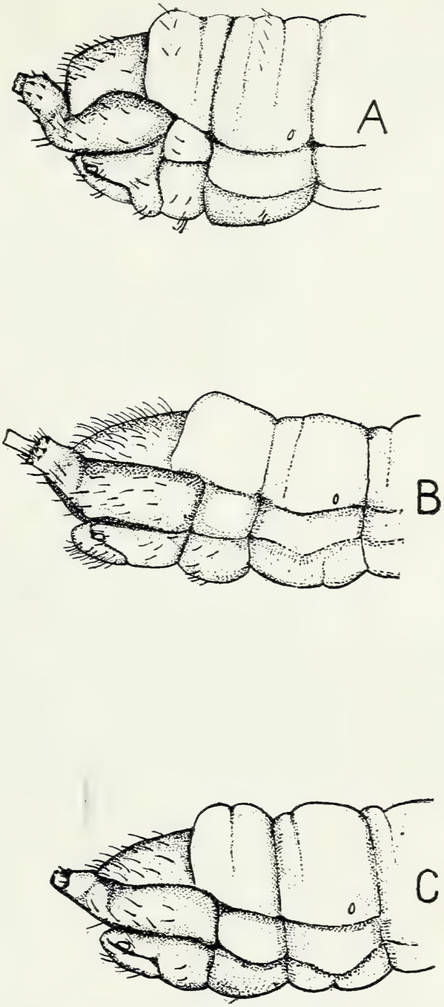
Male.—Similar to female in general appearance and color. Last visible ventral segment of abdomen prominent and extending beyond last dorsal segment; two ventral segments before last visible segment each with a broad, deep, horseshoe-shaped depression, within which is a transverse row of stiff, erect bristles. (See Pl. II, B.)

The only species occurring in America, so far as known, with which this species is likely to be confused are *Cephus cinctus* Norton and *Cephus pygmaeus* Linnaeus. The female may be readily distinguished by the fact that in both *cinctus* and *pygmaeus* the sheaths are narrower at apex than in the middle, and the dorsal segments are banded apically with yellow. The legs are also more largely yellowish. The male of *tabidus* differs from the males of the other two species in the presence of the horseshoe-shaped depression on the two ventral segments as well as by the color characters pointed out for the female.

OVERWINTERING LARVA.

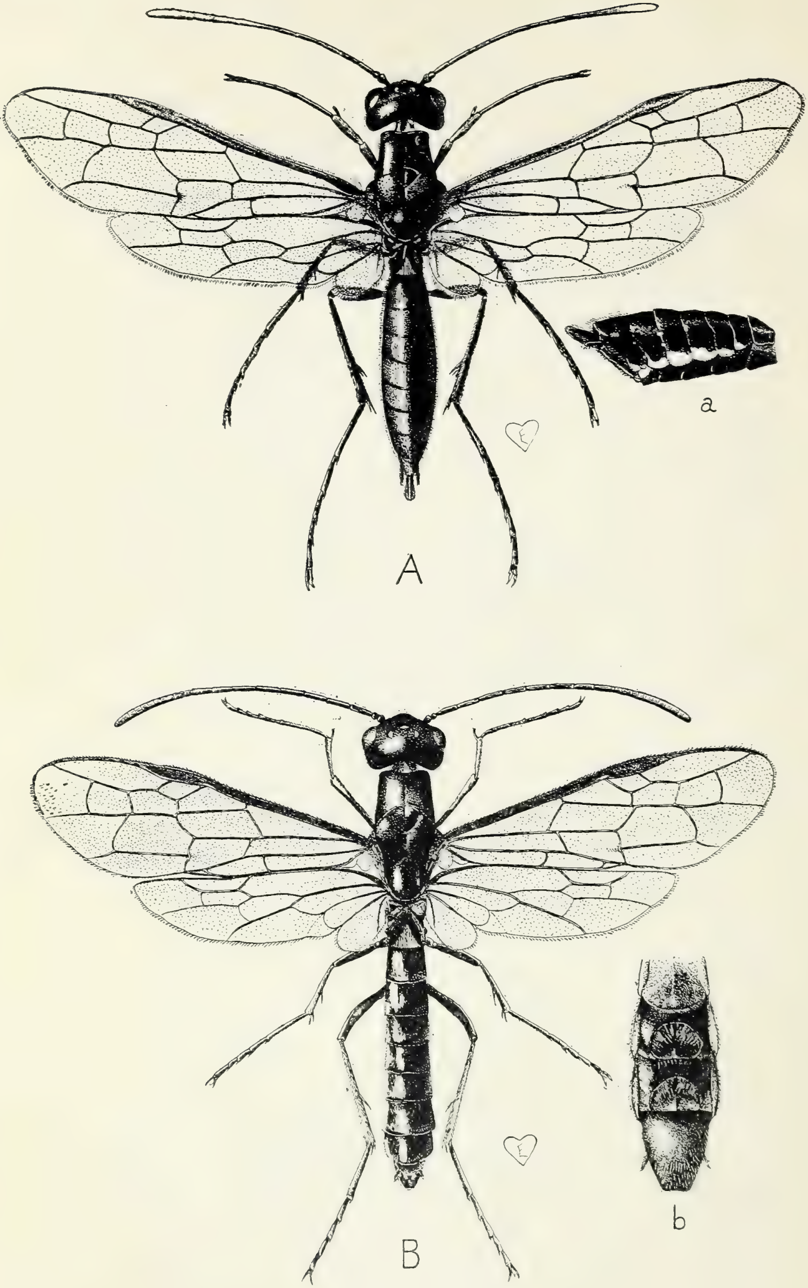
Body subcylindrical, yellowish white in color, 7 to 9 mm. in length, thoracic region slightly thicker than abdominal region. Living larvæ more or less tinged with greenish due to body contents.

Head pale yellow, its dorso-ventral length 1.1 mm., breadth 1.1 mm. Antennæ 5-jointed, tapering to a point at apex, more or less fuscous in color. Mandibles four-toothed, brownish, their apices nearly black; labrum, sutures about



THE BLACK GRAIN-STEM SAWFLY OF EUROPE IN THE UNITED STATES.

A, *Trachelus tabidus:* Lateral view of apical segments of larva; B, *Cephus cinctus:* Lateral view of apical segments of larva; C, *Cephus pygmaeus:* Lateral view of apical segments of larva.



TRACHELUS TABIDUS.

A, Adult female: *a*, Lateral view of female abdomen. B, Adult male: *b*, Ventral view of male abdomen.

clypeus, and articulations of mandibles brownish. Thoracic legs small, papilliform, and pale brownish. Dorsal abdominal segments triannulate; pleura prominent; ventral segments triannulate; prolegs absent. (For further description see Plate I, A, and key to larvæ.)

Larvæ of this species are apt to be confused with those of *Cephus pygmaeus* and *C. cinctus*. All three species infest the small grain crops in practically the same manner, have very similar biologies, and superficially resemble one another closely. The following key in conjunction with the accompanying figures will, it is believed, make it possible to recognize them:

KEY FOR SEPARATING GRAIN-INFESTING SAWFLY LARVÆ.

1. Dorsal anal lobe of the tenth tergite viewed from the side triangular, sloping gradually from base to apex, the anterior end of lobe much thicker than the posterior end which is more or less acute. Spines on the anal prong each arising from a small, more or less chitinized tubercule and closely grouped about the apex of the enlarged fleshy portion just basad of the short chitinized apical ring. Eighth and ninth tergites apparently glabrous-- 2.

Dorsal and lobe viewed from the side not triangular, not sloping gradually from base to apex but convexly rounded, the posterior end of the lobe as thick dorso-ventrally as the anterior end and nearly perpendicular. Anal prong completely encircled by two irregular series of widely separated, short, stiff spines which do not arise from chitinized tubercules. Eighth and ninth tergites each with a transverse row of distinct short hairs. (See Plate I, A.)------------------------*Trachelus tabidus* Fab.

2. Anal prong terminating in a short chitinized ring which is not as long as broad. Spines basad of chitinized ring few in number, confined to a single transverse row on the dorsal surface. Dorsal, lateral, and ventral lobes all sparsely hairy. (See Pl. I, A.)----------------*Cephus pygmaeus* Linn.

Anal prong terminating in a chitinized tube-like process which is distinctly longer than broad. Spines basad of the apical tube-like process numerous, arranged in two irregular contiguous series completely encircling base of tube. Anal lobes all more distinctly hairy. (See Pl. I, A.)--*Cephus cinctus* Nort.

MANNER OF WORK AND PROBABLE LIFE HISTORY.

Observations by the writer supplemented by those of McConnell and Myers, and confirmed in part by Kulagin (47) indicate that the life history of *Trachelus tabidus* does not differ greatly from that of the western grass-stem sawfly, *Cephus cinctus*. The early stages have not yet been observed in this country. Collections of adults in the field indicate that egg-laying takes place during the period May 15 to June 10. Some of the emergence records for reared specimens show somewhat earlier dates than May 15, but since these were obtained under the abnormal conditions of the laboratory they may be disregarded. Kulagin indicates about the same period for egg-laying in Russia.

The eggs are inserted in a slit made by the female in the stem some distance above the ground. The young larvæ burrow downward through the pith of the stem, hollowing it out to the base. The larvæ apparently attain full growth at about the time the grain is ripe. At the time the writer's investigations were begun, July 22, they were full grown and had evidently gone into hibernation. The fully-developed larvæ were, at this time, located at the extreme base of the stem, encased in a silken tube or lining to the burrow, this tube being two or three times the length of the larva and filling the hollow straw completely from about the surface of the ground downward. Above this silken tube the burrow is completely closed by a wad of frass. Before this wad of frass is put in place the larva almost completely severs the stem from the inside, this cut in nearly every case being at or very near the surface of the ground and usually a little above the first node on the stem where the surface roots put out. In making this cut just enough of the epidermis of the straw is left unsevered to attach it lightly and allow it to stand erect. In consequence of this cut the first slight bending of the ripened straw, as by a strong wind, causes it to snap off and fall.

Straws cut off by the insect are easily distinguishable from those severed by the harvester. The cut is exactly transverse to the stem and the ends of both the stub which remains in the ground and the fallen straw are distinctly concave or funnel-shaped. This appearance is so characteristic that one can readily detect the presence of the pest in a field by simply examining the ends of the fallen straws.

The hibernating larva, as already stated, is to be found in the stub of the wheat stalk remaining in the ground. Since this stub in most cases barely extends to the surface of the soil (sometimes a little above the surface), it is not always an easy matter to locate it. The fallen straws sometimes remain slightly attached on one side to the stub, and in such instances one can locate the infested stub by following the straw to its base. When the straw is completely detached, as is usually the case in a field that has been harvested, it is often necessary to search for some time before the stub containing the larva can be located.

The greater part of the insect's life cycle is apparently spent as a hibernating larva, this period extending from about the time the wheat is ripe enough to cut until some time the following spring when the larva changes to the pupa. Just when this change takes place has not been ascertained, but the pupal state is probably of short duration, as in *Cephus cinctus;* if so, the change to the pupa probably occurs in the latter part of April or early part of May. Adults, as already stated, are to be found in the fields during the latter half of May and early June.

In the case of one male specimen reared from wheat stubble by McConnell, the insect was collected as a larva September 30, 1915, and emerged as an adult May 3, 1917. This shows that under some conditions the life cycle may be extended over a two-year period. Such instances are probably rare under natural conditions, but the record indicates a high degree of adaptability on the part of the species for overcoming unfavorable conditions.

EXTENT AND CHARACTER OF INJURY.

Shortly after receipt of the complaint from Gaithersburg, and before the identity of the insect was known, the writer was detailed to visit the locality and investigate the nature and extent of the damage. Accordingly, on July 22, 1918, the farm of the correspondent, Mr. Beverly R. Codwise, was visited. It lies about 3 miles north of Gaithersburg on the road to Laytonsville, Md. Unfortunately the infested fields had already been harvested, making it practically impossible to estimate the extent of the actual injury. It was evident, however, that there had been an appreciable loss due to falling of the grain, so that it could not be picked up by the binder. The writer was informed that comment by passers-by on the large amount of grain missed by the binder had first called attention to the injury and caused the investigation which resulted in the sending of samples to the Bureau of Entomology.

Three other farms in the neighborhood of Gaithersburg were visited, on each of which the pest was located. Subsequently wheat fields in various other localities in Maryland and one in Virginia were visited, with the result that in every wheat field examined the insect was found to be present in varying abundance.

No actual counts of infested straw were made by the writer in any of the fields to ascertain the percentage of infestation. It was roughly estimated that in some of the worst cases the infestation amounted to 4 or 5 per cent. In most of the fields the infestation was much less than 4 per cent. Messrs. McConnell and Myers did make counts of the infested stubble on a small number of experimental plats and other fields of wheat at Carlisle and Mount Holly Springs, Pa., with the results showing an infestation varying from 4.36 per cent on one of the plats to 0.26 per cent on another, the average from all counts being 1.75 per cent.

That a 4 per cent infestation of stubble necessarily indicates a 4 per cent loss in the crop is not probable. The insect apparently chooses only well-developed and vigorous stems in which to oviposit, and some of these infested stems are known to develop at least partially filled heads. Just what the loss, if any, from failure of the heads on infested stalks to fill properly may be, remains to be determined.

It is certain that serious loss may and does occur because of falling of the grain due to the cut made by the larva preparatory to hibernation. The extent of this loss will in all probability depend in some degree upon weather conditions during the period of ripening of the grain. A heavy wind or severe storm at this time would cause most of the infested grain stalks to break off and fall so that they would not be picked up by the harvester. In the absence of such a wind or storm, the loss would undoubtedly be much less, but even with favorable conditions a certain percentage of the infested stalks would be broken off by the harvester reel and fall in front of the platform.

Kulagin (47) states that losses in Russia due to this species and *Cephus pygmaeus* are estimated at 14 to 20 per cent, although more severe in some cases. Shtchegolev (49) also reports 15 to 20 per cent injury due to these two pests. Other Russian writers record severe injury without specifying the amount. Unfortunately, in practically every instance these writers treat of the injury by *Cephus pygmaeus* and *Trachelus tabidus* collectively, without indicating how much of the damage is chargeable to each. This is no doubt due to the fact that they have been unable to distinguish the larvæ of the two species. Their records, therefore, do not afford a reliable basis for estimating the probable future importance of *Trachelus tabidus* in this country.

PARASITES.

In Russia two parasites of *Trachelus tabidus* have been recorded. *Collyria calcitrator* (Gravenhorst), an ichneumonid wasp, is apparently a common parasite of this species as well as of *Cephus pygmaeus.* Borodin (52) records the chalcidid *Arthrolysis* (*Picrocystus*) *scabricula* Nees as having been reared from these two sawfly pests. Neither of these species has, as yet, been found in America.

The existence of at least one efficient parasite in America has, however, been established. Numerous specimens of a chalcidoid belonging to the genus Pleurotropis and apparently representing an undescribed species have been reared by Mr. W. R. McConnell at Mount Holly Springs and Carlisle, Pa. So far little is known of the life history of the species. It emerges from the prepupal larva of the Trachelus at about the time of emergence of the host adults and is believed to be a primary parasite, solitary in its habit. Observations to date are too limited in extent to form a very accurate estimate of the efficiency of this parasite, but in some instances at least it appears to exercise a considerable degree of control.

SUGGESTIONS FOR CONTROL.

In the present state of our knowledge of this species only suggestions of possible means of control can be given.

Measures for control will doubtless be similar to those against *Cephus cinctus*, the western grass-stem sawfly, and *Cephus pygmaeus*.

It is obviously impracticable to attack the insect in the egg stage or active larva stage, since both stages occur in the growing grain. The adult can not be reached by any known method. It appears, therefore, that control measures to be successful must either aim at destruction of the hibernating larva or pupa while in the stubble, where the insect passes the greater part of its existence, or be confined to cultural methods such as crop rotation. The fact that the larva is located in the part of the stem below the surface of the ground precludes the possibility of accomplishing anything by any ordinary burning of the stubble. Disking the stubble thoroughly as soon after cutting the grain as practicable would possibly be of benefit by turning the infested stubble out and thus exposing the larva to the action of summer heat and winter cold. The larva is quite hardy, however, and only experimentation will prove or disprove the effectiveness of disking.

In Russia plowing down of the stubble as deeply as possible is recommended against this species as well as against *Cephus pygmaeus*. The same treatment is recommended and has proved successful against *Cephus cinctus* in this country, and it seems the logical treatment for adoption against this species. To be effective the plowing must bury the stub containing the larva so deeply that the maturing adult will be unable to escape. Shallow plowing will not suffice, as the adults undoubtedly will be able to burrow their way out if covered with only 2 or 3 inches of soil. Deep and clean plowing, therefore, will be essential. The plowing may be done at any time between the cutting of the grain and the following spring prior to emergence of the adults in April or May.

If, as now seems probable, this insect confines itself, in this country, to the small-grain crops as host plants, there can be little doubt that crop rotation will prove an effective means of reducing damage from it. Wheat, barley, or rye should be followed by some crop which will not serve as a host plant, such as corn or truck crops. The present practice on some farms of growing wheat on the same ground two years in succession is distinctly favorable to the propagation of the pest since the adults upon emerging find themselves surrounded by ideal conditions for oviposition. The practice also of sowing grass or clover with wheat and allowing the wheat stubble containing the larva to stand undisturbed for two seasons could hardly be improved upon as means of increasing the numbers of this insect. Any system of rotation to be effective should insure thorough plowing down of the wheat stubble and the growing of some crop other than a small grain following wheat.

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